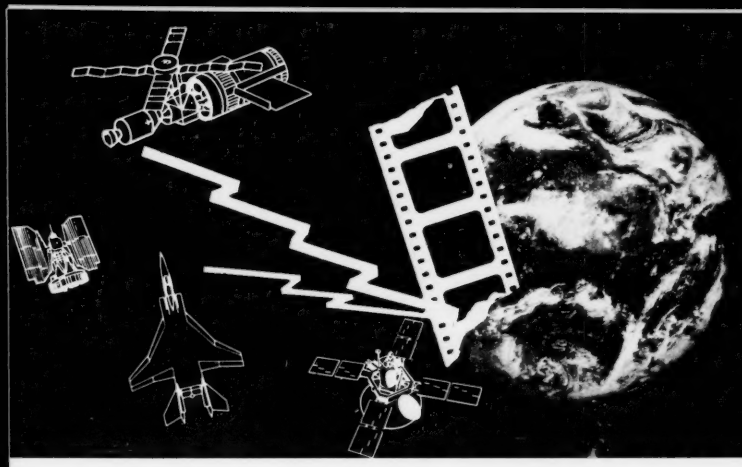

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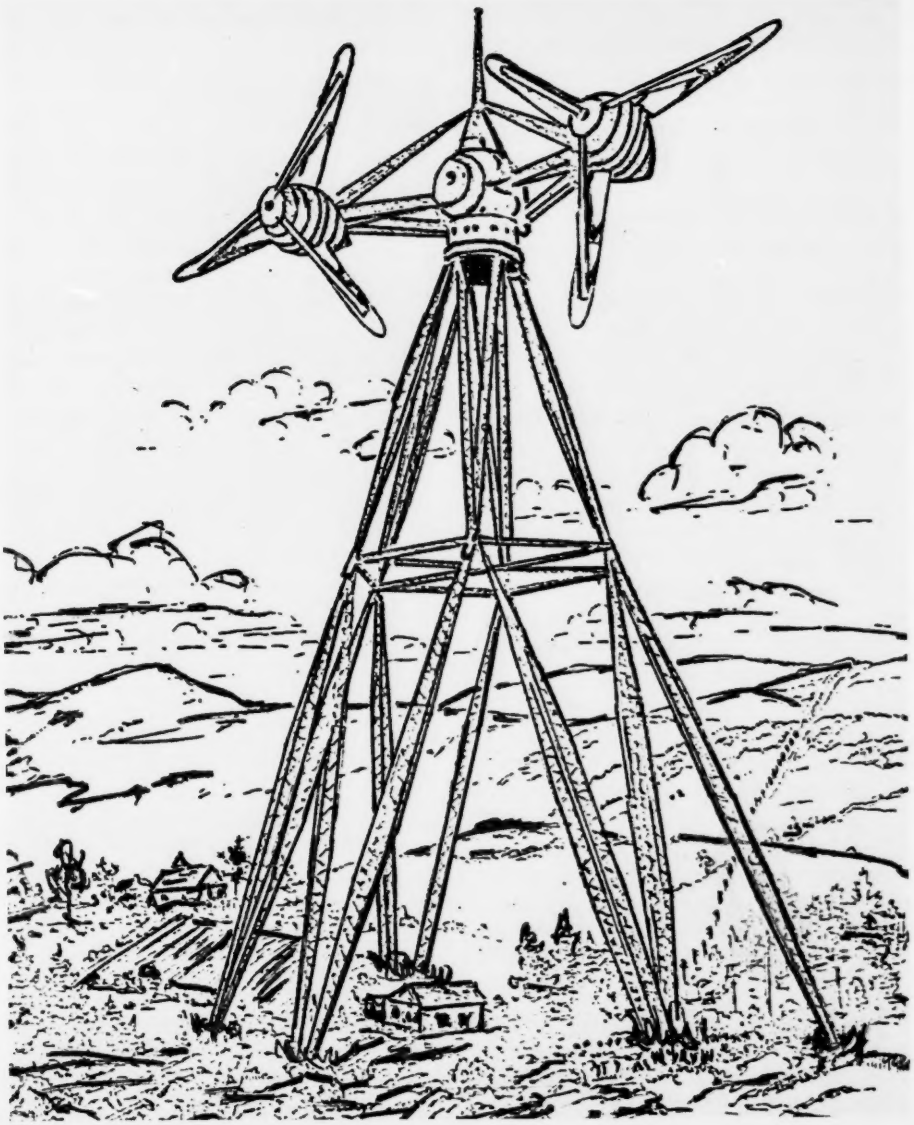

TABLE OF CONTENTS

Letter from Washington	46
NASA Exceeds Energy Conservation Goal	48
Space R&D Applied to Energy Drive	50
What Installations Are Doing to Save Energy	51
Kapryan Optimistic About Energy Solutions	57
Space Education Program	58
Myers Leaves NASA	59
New WPPR Program Spreads	59
Mitzel Awarded Service Medal	61
Kerwin Discusses Medical Aspects of Skylab	61
ERTS Makes Prospecting Easier	64
FRC Visitors from Aviation Week	64
Standardized SEPS Study	65
Planning for Comet Encke	65
Alan Shepard Honored	65
Skylab Credited with Marking New Start	66
Film Activity	66
Space Processing Symposium	67
Apollo 16 on Display	67
Key Awards	67
Lunar Sample Exhibits	67
Headquarters Press Releases	67
Radio-Television	67
NASA Tech Briefs	68
Patents and Inventions	70
1974 Launch Schedule	70
Your 1¢ Worth From Space	72

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LETTER FROM WASHINGTON

March 1, 1974

Dear Colleagues:

When we talk about NASA and the energy crisis, we are talking about many different things. In this letter, I will try to sort them out so that you can see what the general approaches are, and who is doing what.

There are two main approaches:

One is to conserve energy that NASA itself consumes—that is, the energy used to light and heat (or cool) our buildings and to operate our laboratories, our aircraft, and our ground transportation. Closely related to this is the effort NASA people are making to save energy in their homes and in getting to and from work.

A Plan for NASA Energy Conservation and Management has been distributed to all Program and Staff Offices and Center Directors with a covering memorandum from George Low dated Jan. 17, 1974.

A Special Task Force on Energy Conservation has been set up at NASA Headquarters. It is headed by Gen. Bruce K. Holloway, Special Assistant to the Administrator and Assistant Administrator for Department of Defense and Interagency Affairs. This Special Task Force works directly with the Energy Reduction Coordinator in each Center.

NASA efforts to conserve energy have been highly successful. We have reduced NASA's energy consumption in the first half of Fiscal

COVER

One of the designs suggested for a wind generator, possibly made up of 200-foot-long blades on towers as high as 1,000 feet.

Year 1974 by 18 per cent compared with the first half of FY 1973, and by 24 per cent compared with the energy consumption originally planned for the first half of FY 1974.

Thus we have far exceeded the requirement set by the President for a seven per cent reduction in energy use in FY 1974.

I want to congratulate all of you who have worked so hard over many months to plan and achieve these substantial savings. I also want to express my appreciation for the spirit of cooperation throughout NASA that has made our energy-saving campaign so successful. I emphasize that this must be a continuing effort, and that your ideas and suggestions for future savings will be welcomed.

I am sure you realize that the energy-conserving efforts I have been talking about so far are those expected of every government agency. If there is anything special about NASA's role in this kind of energy conservation, it is only that we have a self-imposed obligation to make a good showing because of our innovative traditions.

But I also want to discuss a second important approach NASA can make to help the nation solve long-range energy problems. This is the R&D approach which would utilize the strong (and in some cases unique) capabilities NASA people and NASA Centers could contribute to problems in and outside of the aerospace field.

We will, of course, continue to do much energy-related work in our regular space and aeronautics programs, and this work will be funded in NASA budgets in the future as in the past.

New opportunities are also opening up for NASA to use its special capabilities on energy work outside the aerospace field. Much of this work will probably be funded by other agencies, with NASA acting, in effect, as a sub-contractor. In recent Congressional testimony, I have supported the President's proposal for the establishment of an Energy Research and Development Administration. I believe that NASA could cooperate very effectively with such an agency and carry out important assignments for it. We have made clear our capabilities and our readiness to work on energy-related assignments in any way the President and the Congress direct.

As you probably know, Dr. Harrison H. Schmitt, the first geologist to explore on the Moon, has been temporarily assigned as my special assistant to coordinate NASA's efforts in energy research and development. One of his first tasks has been to get an accurate and complete picture of the many different kinds of work we are already doing that is related to energy R&D and to get ideas on what else might be done in this high priority field. Dr. Schmitt is also working closely with other agencies on how NASA can help with their energy R&D plans and programs.

Those are NASA's two main approaches to energy problems: (1) to conserve energy within NASA in every way we can, and (2) to carry out energy-related R&D work in our own aerospace programs or in cooperation with other agencies.

NASA, of course, has been doing R&D in aerospace energy systems for 30 years, including 15 years in the solar cell field. We are cooperating with the National Science Foundation and other federal agencies working in energy-related areas.

In solar energy, we have evaluated some interesting system concepts for the future, and have some experimental work underway on the pacing technologies.

The Marshall Space Flight Center plans a test demonstration this June of the solar heating and cooling of three trailers joined to simulate a residence. Later, in 1975, Langley will operate experimental solar cell collectors to provide needed test data, utilizing its new Systems Engineering Building.

Studies to identify the engineering and technology programs required to develop a central solar thermal electric power plant for use in the 1985 time period also have been made. One concept of such an earth-based plant is the Solar Thermal Electric Power Plant (STEPP). An array of solar collectors would direct solar energy onto a single receiver. The energy would then be transferred to a flowing fluid used to drive a generator and produce electricity.

The Office of Coal Research, of the Interior Department, has asked NASA to assist it in determining the feasibility of using a liquid metal Rankine turbine system for central station electric power generating plants. A liquid metal Rankine cycle used as a "topping cycle" in series with a conventional steam Rankine system might achieve a 25 to 40 percent reduction in fuel consumption for the same electric output. The Lewis Research Center is currently investigating this possibility.

We are also cooperating with the Federal Railroad Administration in studying the use of the Brayton cycle and other advanced engine concepts in buses, trucks, and trains. For the Envi-

ronmental Protection Agency, we are assisting in a program to improve the efficiency of a gas turbine engine feasible for automobiles, and are investigating a hydrogen injection concept which might be used in both automobile and small airplane piston engines to conserve fuel and reduce pollution.

Only a few of NASA's energy-related activities can be cited here, but these give an idea of some of the areas in which we are working.

I would also like to mention one very promising and unique capability NASA has to help ease energy shortages. This is the use of "prospector" satellites to help identify the locations where new sources of oil and geothermal energy may be found.

This unique capability has been demonstrated by ERTS-1 and the Earth resources experiments on Skylab, and will be further demonstrated by our proposed Heat Capacity Mapping Mission satellite and other satellites of the future.

I might also mention one of the management techniques we are examining that is of interest to many persons throughout NASA. It is a special effort to achieve savings through the application of communications and computer technologies. A task team to plan and carry out this approach has been set up in the Office of Applications at NASA Headquarters. The task team is headed by Leonard Jaffe.

One project for this special task team will be improvement of communications techniques whereby persons at widely separated points can participate in a "meeting" without travelling. Of course, the idea of a telephone conference is simple enough; what we need is to develop the special techniques and routines that will assure that such a "meeting" will do all, or nearly all, that a face-to-face meeting could do.

Previous NASA programs have made extensive use of teleconferencing.

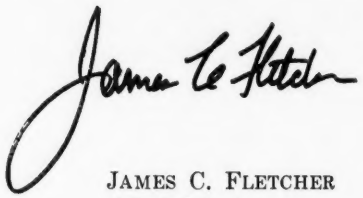
The Apollo Program used a network connecting a dozen conference rooms in NASA and contractor installations. The circuits permitted documents and figures to be broadcast to fast facsimile machines in advance of the scheduled meetings. During the meetings, these figures were projected simultaneously at all participating conference rooms. Voice-actuated microphones allowed the speaker's voice to be heard throughout the network. Each dollar spent on this teleconferencing network saved several dollars in travel costs, and permitted quicker management decisions.

A pilot project under consideration is the extension of this teleconferencing network to all major NASA installations.

Other pilot projects being studied include the use of computer technology to develop management information systems with a central computer and multiple remote interactive terminals. The purpose is to enable management to function efficiently without the proliferation of paper documents.

In closing, I urge you to keep up the good work on energy conservation and to continue exploring ways to use fossil fuels more efficiently or to replace fossil fuels with new fuels and sources of energy.

Sincerely,



JAMES C. FLETCHER
Administrator

NASA FAR EXCEEDS GOAL IN CUTTING ENERGY USE

Reduction in Total Planned for FY 74 Is Reported at 24 Per Cent

The President's request last June for government agencies to reduce their energy consumption by 7 per cent during FY 1974 is getting better cooperation than that from NASA.

Figures for the space agency's energy consumption in the first half of FY 1974 show a 19 per cent drop compared with the first half of FY 1973 (and a 24 per cent drop compared with the energy the agency had originally planned to use in FY 1974).

A combination of factors is given credit for the excellent results, not the least of which is the fact that NASA already was prepared for the emergency. Three years ago it started an energy conservation program, making it possible for the message from the White House to stimulate an immediate acceleration and broadening of the effort.

NASA-WIDE ENERGY SAVINGS
During First Half of FY 1974

Energy Category	Actual Consumption 1st Half FY 73	Originally Planned Consumption 1st Half FY 74	Actual Consumption 1st Half FY 74	Percentage Decrease in BTU Consumption in 1st Half of FY 74	
				Compared With 1st Half FY 73	Compared With Originally Planned Consumption 1st Half FY 74
Vehicle & Equipment Operations					
Gasoline (thousands of gallons)	581	783	608		
BTU (billions)	72	98	76	(increase 6%)	22%
Diesel & Petroleum Distillate (thousands of gallons)	1,284	1,516	1,542		
BTU (billions)	178	311	214	(increase 20%)	(increase 1%)
Aviation Gasoline (thousands of gallons)	442	524	453		
BTU (billions)	56	66	56	0%	15%
Jet Fuel (thousands of gallons)	5,092	6,026	4,215		
BTU (billions)	646	766	536	17%	30%
Buildings & Facilities					
Electricity (thousands of kilowatt hours)	1,164,440	1,164,280	957,469		
BTU* (billions)	12,347	13,506	11,107	10%	18%
Natural Gas (thousands of cubic feet)	3,130,400	3,322,800	1,860,195		
BTU (billions)	3,228	3,427	1,918	41%	44%
Fuel Oil (thousands of gallons)	10,955	9,549	5,819		
BTU (billions)	1,520	1,325	807	47%	39%
Other BTU (billions)	505	561	461	9%	18%
NASA-Wide Totals					
BTU (billions)	18,552	19,960	15,175	18%	24%

* Converts energy at power generating plant and includes 9% line losses. Electricity accounts for 73% of the energy used by NASA in the first half of FY 74; natural gas for 13%; and fuel oil for 5%.

Headquarters and the various NASA installations now are locked in a massive drive not only to cut down on energy consumption, but to find other sources to supplement the present below-normal supply. A memorandum recently sent Center Directors and others by Dr. George M. Low, Deputy Administrator, stated in part:

"The need for a consciousness of personal and national frugality, together with an understanding that the resources of the Earth are not unlimited, is here to stay. Americans have been the last to learn this. Many have learned it or become acutely conscious of it within the past three months, but many still believe the problem is only temporary. It is not, and there is a necessity to convince everyone that an economy which embraces a real-world plan for balancing the projected resources and consumption of energy is vital."

The NASA Energy Conservation Program, as initially established three years ago, was focused on long-term improvement in the management and control of utility systems. Conservation committees were established at each Center and close association with the Office of Emergency Preparedness was maintained, but the program was essentially a "low key" effort focused primarily on costs.

NASA Acts Quickly

Thus already conscious of the problem and with initial planning started, NASA was able to gear up quickly when the request for a government-wide drive arrived. Out went directives seeking all avenues of immediate energy conservation. Energy Reduction Coordinators replaced Conservation Coordinators, and they held their first meeting at Lewis Research Center on July 23.

Attention centered on air and ground vehicular utilization and scheduling, utility management in fixed facilities and installations, wind tunnel scheduling and programming, and a strong agency-wide stimulation for innovation on other ways to become more efficient in energy consumption.

Special activities got under way. Reviews were made of energy management practices and new applications of current technology to facilities. Also studied was the feasibility of saving energy through use of electronic communications, computer access, and computer storage instead of travel, letters, memoranda, and duplicating.

NASA Centers were required to report on their programs monthly, and Headquarters in turn passed the information on to the Interior Department.

In August, Dr. Low notified the Department of the Interior that NASA planned to exceed the President's goal and accomplish at least an 8 per cent reduction.

Contingency Study

The preliminary contingency study on the curtailment of energy resources was completed in December. At that time, Dr. Low issued a memorandum recognizing that the energy crisis in the U.S. required: (1) prompt action by NASA to reduce energy use wherever practicable; (2) a reassessment of NASA's institutional practices and program plans to determine whether further reductions could be made in energy use by the agency and its programs; and (3) that NASA needed to apply its technical and management ingenuity to seek out new and imaginative ways in which to conserve energy.

To provide central leadership and direction, a Special Task Force on Energy Conservation comprised of senior NASA officials was set up under the direction of Gen. Bruce K. Holloway, Special Assistant to the Administrator and Assistant Administrator for Department of Defense and Interagency Affairs.

The Task Force was assigned these functions:

(a) To review and recommend policies and guidelines on energy conservation, (b) consider NASA's response to external energy directives, (c) consider and develop new suggestions for conserving energy, (d) review NASA's program in energy conservation and its impact on NASA's programs, and (e) consider major problems related to NASA's energy conservation activities that may be reported by Task Force members or otherwise be brought to its attention.

The Task Force promptly established Task Group Panels and Committees to support it in the areas of fixed facility and vehicular management, manpower and institutional resources, technological innovations, public affairs, information exchange, and aircraft resources and management.

In January, by memorandum from Dr. Low, a NASA plan to pull all directives, information, and committees together was issued.

"It is expected," Dr. Low stated, "that this plan will require frequent modification in the months ahead as governmental machinery for energy management and control takes more definitive shape, and as Congressional action and funding support materializes. Meanwhile, the top priority effort is conservational and managerial in nature and broadly applicable in scope."

The plan stated flatly: "We are encouraging carpools through better discipline in working hour scheduling, parking advantages, and identification of potential customers."

Reports during January indicated that more than 7,500 carpools were operating in 13 NASA installations and Headquarters. Those at Headquarters are averaging 3.95 persons per car.

R&D RESULTING FROM SPACE EFFORT USED IN SEEKING ENERGY SOLUTIONS

NASA Is Playing Major Role in Nation's Search for New Methods and Sources

To implement the President's policy calling for U.S. self-sufficiency in energy by 1980 requires significant advances in energy conservation and conversion.

The nation is fortunate in having a special competence in the scientific and engineering disciplines concerned. Available are the facilities, the highly motivated and experienced personnel, and a wealth of technology and expertise derived from the aerospace program.

A basic element in aeronautics and space R&D is the conversion of solar, nuclear, and chemical energy into mechanical and electrical power. The scientific and engineering disciplines employed are the same in principle as those required for providing energy and to meet civil or terrestrial needs. To convert heat into mechanical and ultimately electrical energy, electric generating plants require the same technologies of turbomachinery, thermodynamics, fluid mechanics, and heat transfer that are basic to aerospace propulsion and power applications. Solar cells and fuel cells, developed for spaceflight, provide direct conversion of radiant and chemical energy, respectively to electrical energy, and have a potential and terrestrial use.

Power processing and cryogenic technologies, developed and extended for aerospace applications, may well be applied to the processing and transmission of electrical energy on Earth. Advances in chemistry, chemical kinetics, and materials required for aerospace projects also have their applications in much the same way in many aspects of ground energy systems.

Another basic element of approach is to conduct

research and development in aerospace problems in systems engineering. This is the phased project approach to systems engineering defined as the methodology for achieving acceptable solutions within the constraints imposed by specific problems. Its function is to translate mission requirements in constraints such as size, weight, cost, and lifetime for a given system concept into detailed statements of the technical performance required.

Approach Is Similar

The systems engineering approach and basic technical capabilities that are derived to develop a low-cost jet aircraft engine, for example, are the same as those needed to develop an acceptable automobile turbine engine. The difference in approach and the eventual product merely reflect the constraints imposed by the individual aircraft and car problems.

The need for new materials, and special applications of older, more familiar materials, is also a common thread through all of the various technology programs related to the conversion and conservation of energy. NASA R&D on heat-resisting materials, such as ceramics, superalloys, and refractory metals, for example, although motivated by aerospace requirements, has direct application to ground transportation and stationary power-generating plants. In most cases there is a meaningful analogy between aerospace and terrestrial components, after the allowance is made for differences in size, weight, service lifetime, and cost.

In addition to NASA's activities in power conversion, there are projects to improve overall vehicle performance and efficiency through new design concepts, aerodynamics, and structural advances. Current new technology that NASA is developing, for instance, could permit the next generation of U.S. transport aircraft to achieve a 30 per cent or more increase in passenger miles flown per gallon of fuel. Similarly, the agency is investigating means to reduce aerodynamic drag of box-shaped vehicles such as trucks, which have high drag and thus increase energy management problems.

Long-Term Needs Important

So far, the type of activities discussed pertains to near-term aspects of the energy problem on which NASA's capabilities can be brought to bear. The long-term requirements—beyond 1985—are perhaps even more important. In some of these, such as extraterrestrial solar power generating stations in geosynchronous Earth orbit, and microwave power transmission systems, the space agency offers a unique potential.

Accelerating energy needs of the world's population points up the urgency of an early start in preparing to meet those requirements. Ample energy is basic to the maintenance and future growth of civilized communities. Programs to meet the energy needs of 25 or 30 years from now entail long lead times to develop and deploy.

Today the nation is receiving an object lesson not only on the fundamental role played by energy in our society, but also on the value of timeliness in bringing in new or alternate sources of energy conversion.

WHAT THE INSTALLATIONS ARE DOING TO SAVE ENERGY

AMES RESEARCH CENTER

Ames Research Center, the national aeronautical research laboratory established in northern California because of the availability of abundant and inexpensive electrical power, has established an energy conservation plan aimed at reducing consumption by from 14 to 15 per cent annually.

These approximate figures for energy use in FY 1974 have been set:

Electricity—320 million kilowatt hours, a drop of 50 million.

Natural gas—450 million cubic feet, a drop of 60 million.

Aircraft fuel—2 million gallons, a drop of 500,000 gallons.

Wind tunnels require about two-thirds of the electrical energy used at Ames. The remainder is needed for computers, laboratory operations, lighting and other institutional needs.

But wind tunnels are themselves energy saving devices, for they "flight test" aircraft design on the ground to improve aircraft operating efficiency. For example, tests on two commercial jet aircraft resulted in design refinements which saved 3.7 million gallons of jet fuel per year.

An engineering program is now under way to

improve wind tunnel data gathering devices which when complete will enable tunnels to use 20 per cent less power and still obtain the required test data.

The Center reports that most of its employees are taking steps to conserve energy both at home and at work. One of them wrote: "I have a waterbed and, because it is a powerful heat sink, I had always heated it with an electric heating mat. I bought a one-inch-thick foam pad for insulation and turned off my heater. I also draped my sleeping bag over the bed as a quilt and cut back my apartment's thermostat."

Many Ames employees bicycle to work. Others have indicated they would do so if a safer bicycle crossing of Bayshore Freeway were provided.

Here are other suggested steps to conserve energy:

- Turn off all lighting in unused or infrequently used areas. Install a manual timing switch for rooms or areas used intermittently. Check where switching can be easily installed so lighting can be turned off when the space is unoccupied.
- Reduce lighting in hallways and passageways to no more than the level required to meet safety regulations.
- Reduce general illumination in work areas to a minimum level consistent with task requirements. Use available natural light in appropriate areas.
- Reduce or turn off (during non-operating hours) all lighting not required for safety, security, or maintenance work being performed in the immediate area. Where possible, schedule cleaning crews to overlap with regular working hours.
- Identify lighting switches and indicate hours to be operated in the on-off position.
- Reduce or turn off decorative lighting.
- Turn off exterior and sign lighting during non-business hours.
- Check reflective surfaces and repaint darker areas with higher reflective paint.
- Maintain parking area lighting levels consistent with safety regulations, and reduce or turn off during non-business or non-operating hours. Reset timer once each week as hours of daylight change.
- Check all plant and office lighting and clean fixtures regularly. Remember: use of fluorescent lighting instead of incandescent lighting reduces power consumption by more than 60 per cent while maintaining the same illumination level.

FLIGHT RESEARCH CENTER

A broad program of energy conservation that reduced use of electricity by 20.7 per cent and of natural gas by 24.74 per cent during the first half of FY 74, as compared to the same period of FY 73, has been put into effect at Flight Research Center. Two research projects now are aimed at finding new ways to save.

Because of its location so far from local communities—a majority of its more than 650 Civil Service and contractor employees commute an average distance of 68 miles round trip per day—FRC has concentrated on carpools, establishing a center to disseminate information concerning them. At present, 69 per cent of its employees are using carpools, with only 12 per cent driving alone, while 19 per cent use buses to get to and from work.

Unnecessary use of Center staff cars on base has been discouraged and use of the regular shuttle bus urged. Government cars have been reduced from seven to five and their speed limited to 50 mph.

In putting the overall program into effect, thermostats were lowered to 68 degrees, lighting was reduced to the lowest possible safe level, unnecessary car trips and airplane flights were banned, lights were turned off in the evenings and on weekends, weatherstripping was applied to outside doors, and vestibules were installed on outside doors used most frequently.

Original 1,000-watt incandescent fixtures in three hangars were replaced with 1,095-watt metal halide fixtures, with a resultant increase of four times the footcandle level of illumination in the working surface.

The Center Energy Conservation Coordinator has installed a bulletin board near the cafeteria to provide employees with up-to-date information on conservation methods. Moreover, the Center house organ runs a special column on information of this nature.

Employees are encouraged to give up minor creature comforts and luxuries, such as electric hairdryers, makeup mirrors and electric shavers, and to turn to "old-fashioned" methods wherever possible, including drying dishes by hand and using candles and fireplaces. One worker found

that, by substituting a microwave oven for his regular oven, he used 25 per cent less electricity.

Under an Incentive Awards Program, workers are encouraged to turn in energy-saving ideas. Honorary and cash awards are given for suggestions, identification of problems, and solutions.

Capitalizing on the abundant sunshine in the Mojave Desert, the FRC is examining small solar collectors for possible use in heating and cooling the Center. Based on these studies, a decision may be made to build a large collector and put it into use.

Employing technology gained in measuring aerodynamic drag on aircraft, engineers are looking at ways to modify certain van-shaped trucks to make them more efficient. Ground tests have demonstrated that, by rounding corners of trucks and other such procedures, it is possible to reduce the aerodynamic drag on the vehicle. It is believed this could lead to an overall increase in efficiency and result in reduction of gasoline usage and pollution.

GODDARD SPACE FLIGHT CENTER

Like other NASA installations, Goddard Space Flight Center has more than met the goals of President Nixon's directive to reduce energy usage by 7 per cent.

Through January, Goddard had cut fossil fuel (gas and oil) use by 26 per cent and electricity by 12 per cent. This reduction, officials report, was accomplished by employee cooperation, a mild winter, and the Plant Operation and Maintenance Division's work in keeping buildings at temperatures of 65 to 68 degrees.

Carpools have been encouraged and employees are forming them in increasing numbers. In late December, carpool questionnaires were sent out to all 6,000 government and contractor personnel. Some 2,100 replied, 800 of them indicating a desire to join a carpool. They have been furnished names of persons in their zip code areas who also are interested.

A gate count taken in late January indicated that about 1,450 persons may now use carpools. At least, that many were counted coming into the Center with two or more in each car. To check on progress, more gate counts are planned.

Another area Goddard is looking into is the use of charter bus transportation. Where there are large concentrations of employees, there may be a sufficient number to band together for an economically attractive charter bus operation. Personnel in two likely areas are being polled to see if there is a sufficient number to pursue the matter.

In order to encourage everyone to think "Save Energy," a committee was formed in November to solicit ideas for savings for all employees. There have been more than 250 replies, and the committee is evaluating them to see which might be useful to management or personnel.

For example, one suggestion which seemed to promise substantial savings involved using heat generated by computers. However, in order to capture the heat, extensive modification work would have to be done, and this would cost far more than the savings to be realized.

So far, Goddard has erected no windmills or deployed any solar cells, but nothing is being ruled out. The goal is to bring energy use down to a minimum consistent with good operations. This has meant, mostly, simple things any good householder can do: turn off or remove unneeded lights; turn the temperature up or down, depending on the season, and shut off all unnecessary equipment, from cars to computers.

JET PROPULSION LABORATORY

"Through your individual efforts, the Laboratory's Energy Reduction Program has produced significant results with increased percentage reductions in all categories."

This is how the success of the energy conservation drive at the Jet Propulsion Laboratory was characterized in a February report by Energy Reduction Coordinator T. G. Meikle, who also serves as Manager of Facilities and Plant Engineering.

The energy conservation effort began at JPL last fall with the announced attention and call for cooperation of employees to reduce measurably use of electrical energy. Coupled with this request was the recommendation that employees institute energy conservation measures at home.

A bulletin board poster campaign has been launched, and various announcements, articles and appeals to reduce energy consumption have appeared in JPL employee publications.

Additional teeth have been put into the already vigorous campaign with the appointment early in January by Dr. William H. Pickering, JPL Director, of Walter K. Victor as Chairman of the Energy Program Steering Committee. Victor's group is studying the long-range implications of a curtailed energy situation, and possible ways, means, and alternatives of coping with the pre-

dicament, using, insofar as possible, the Lab's technological expertise.

Victor is Deputy Assistant Laboratory Director for Tracking and Data Acquisition. His committee also incorporates Meikle's energy reduction campaign.

Carpooling at JPL has also been given new emphasis and has found new disciples in the face of curtailed gasoline supplies. A computerized run of JPL employees by home neighborhood has for some years been available to potential carpoolers as a service of the Employees Recreation Club.

This service has recently been given greater attention and visibility, and moved to a more central location, with the result that carpools, once largely an exception, are more generally the rule today. Carpoolers enjoy the additional advantage of an assigned space in convenient parking areas —a feature coordinated by the Lab's Plant Security Section.

Some new—or at least "refresher"—guidelines in the use of government vehicles, especially such use by employees using passenger vehicles for official business, have been published. These include such tips as trying to double up on passengers and errands and avoiding gunning the engine at traffic signals.

JOHNSON SPACE CENTER

A three-part conservation program put into effect at Johnson Space Center is estimated to have saved $100,000 in energy costs between July and December. The goal now is to set a better record in the future.

The overall program seeks (1) to save power through changes in work hours or procedures and through minor modifications to facilities and equipment; (2) modifications in the Center to conserve energy; and (3) research and development looking toward long-range benefits to people both there and elsewhere.

Energy reductions at JSC—in non-essential lighting, adjustments in heating and cooling requirements, and limitations on official transportation—have come at a time when Skylab missions were in progress. In December, the usage was 23.9 per cent lower than anticipated on a basis of previous years' figures.

This result was brought about by cutting lighting by as much as three-fourths in some areas, by permitting a wider range of temperatures inside buildings, by improving control of heating and cooling systems, by withholding one-fourth of the approved travel budget, and by reducing aircraft use one-fifth.

Not only was natural gas, electricity, and liquid fuel consumption conservation put into effect at the Center, but employees also were encouraged to conserve at home.

Carpools were promoted, with preferential parking for those who shared them. About 800 fewer cars now are driven at JSC, while correspondingly the number of riders per car has increased. A test project to evaluate the potential for commuter buses to carry employees to and from residential developments is under consideration.

Center officials also are considering a plan to reclaim heat loss through the exhaust stacks from boilers at the Central Heating and Cooling Plant. An engineering study will be necessary to evaluate this.

A computerized control system to manage power use is also being weighed as a means of saving energy and dollars through technological investment.

KENNEDY SPACE CENTER

Kennedy Space Center has launched the first stages of a computer-backed carpool program for its 11,000-plus workers, and officials say it could save 3,000,000 gallons of gas per year.

Already its concerted energy conservation program has resulted in substantial savings of both electricity and fuels, they report. Fuel oil consumption has been reduced 24.8 per cent and electricity 18.5 per cent, while mileage on government vehicles has been cut by 20 per cent.

When daylight saving time was resumed in January, the Center abandoned its policy of staggering shifts to reduce traffic congestion. This change was coordinated with the computerized program designed to encourage employees to join carpools. Card-sized questionnaires were sent each worker. The information thus assembled made it possible to organize carpools by areas. In addition, bulletin boards were placed in the lobbies of major buildings. Officials estimate an increase of one passenger per vehicle will save the estimated millions of gallons of fuel annually.

The savings already realized have resulted from detailed evaluation of energy use and alternatives throughout the Center. Air conditioning and heating systems were a prime energy reduction target area.

Where possible, air conditioning and related

BUS TRAVEL ENCOURAGED AT KSC—Passenger volume on KSC's shuttle buses increased 250 per cent during January as the Center encouraged employees to use the service for commuting between the Industrial Area and Complex 39. Here workers depart a bus at Pad B of the Complex, as others wait to board.

equipment—fans, water pumps, compressors and some of the cooling towers which circulate water for cooling the air—were shut off in unoccupied areas and during periods of light use in other areas.

KSC also has a continuing program to remove interior and exterior light fixtures without jeopardizing health or safety. Some 45,500 lamps have been removed for a total annual reduction of 2,374,280 watts.

Further electricity savings have resulted from cutbacks in elevator service in all buildings. Service in elevator banks has been reduced to one operating elevator. Signs near them encourage: "Conserve Energy: Walk up One Flight; Down Two Flights."

Advance planning enabled the Center to achieve substantial energy savings during the Christmas holidays. Manpower surveys in each work section showed many areas where lights and air conditioning could be shut off for the duration of the holiday. As a result, the Center used 1,300,000 fewer kilowatt hours of electricity during the period than during the first 10 days of December.

Transportation has also felt the impact of the energy crisis. Effective last August 2, a 40-mph speed limit was put into effect for all government vehicles. The limit was extended to civilian vehicles on Nov. 28.

To further encourage gasoline savings, the Center suspended Sunday drive-through tours. An average of 200 to 300 cars traveled the 50-mile route each Sunday.

LANGLEY RESEARCH CENTER

In keeping with the President's directive to all Federal agencies, all thermostats at the Langley Research Center have been turned back to 68 degrees and a survey of light levels has been made in all facilities and reduced where found excessive.

The Center's heating system does not lend itself to shutting off the steam to its various facilities completely. As an alternative, the air moving equipment of 36 selected facilities are being shut down over the weekends and a significant reduction in oil consumption has resulted. For the month of December, the total dropped from 393,000 gallons in 1972 to 316,000 in 1973, even though the period during 1973 was a colder month.

Through a number of procedures that included shutting down of selected mechanical air conditioning systems, reduced lighting, and closer scheduling of auxiliary equipment, a 20 per cent reduction in baseload electric power was obtained.

The operational test levels have been reduced in several Langley Research Center wind tunnels to effect an annual energy saving of 15.5 million kilowatt hours.

Staff members have been encouraged to form carpools. A computerized grid system has been established to aid them in identifying persons living in the same geographic location and their work shift.

LEWIS RESEARCH CENTER

A wide range of sweeping operational changes by the Lewis Energy Reduction Committee led to

a 23 per cent dip in energy usage there during the first half of the fiscal year.

The committee zeroed in on the three biggest energy users at Lewis—electric power for such big facilities as the supersonic wind tunnels and for institutional lights; gas for heating, research and development, and the wind tunnel dryer; and jet fuels for research and development runs. Several on-going programs were incorporated to curb excessive use.

Institutional cutbacks included a "lights out" program, a Centerwide across-the-board reduction in temperature to 68 degrees, and fewer transportation trips.

Research and development improvements included shorter run-time for data required from tests, plus careful planning and scheduling of research runs.

Another innovation was the introduction of a half-hour-earlier Center starting time for the purpose of encouraging more carpools. In this connection, Norman T. Musial, Lewis' Patent Counsel, was named to head a committee to encourage Cleveland-area Federal workers, in and outside of LeRC, to form pools, A master list of where workers live was compiled.

According to Musial, some 320 carpools involving 800 persons are in operation at Lewis, saving an estimated 5,000 gallons of gas per week. Only a year ago, just half that number existed.

"Barring any unforeseen turn of events in the energy crisis, I think there will be 150 more carpools at Lewis within the next two months," Musial predicted.

MARSHALL SPACE FLIGHT CENTER

At the Marshall Space Flight Center, the NASA installation with the largest Civil Service work force, a busy retrenchment program, ranging from closed buildings to stepped-up carpools, has been under way since the directive for energy conservation was released.

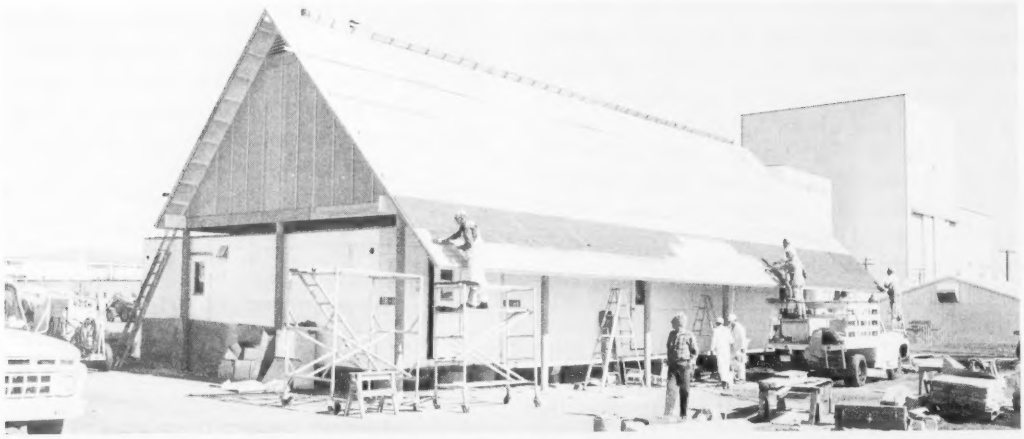
The move was in line with a gradual reduction in work force and in missions and programs since the peak of operations at this center in 1965. More than 2,000 Civil Service employees, with a corresponding reduction in contractor personnel, have been trimmed from the rolls since that time.

Facilities closed represented a wide variety of specialized structures ranging from test observation bunkers to test stands and laboratory buildings, and involved a 10 per cent reduction in office space and a 20 per cent cutback in warehouse space.

The number of vehicles of all types used at the Center were reduced by several hundred. House trailers were vacated. Communications equipment and services were reduced. Office, laboratory, shop, and test equipment in excess of needs was turned in to the Supply Department.

Thermostats in offices and laboratories were ordered set at 68 degrees, and shop areas were cut back to 65 degrees. Areas unused for periods of more than one day were to be heated only to avoid damage to facilities and equipment, and warehouses with material in them were prescribed a maximum of 40 degrees.

Air conditioning was ordered turned off, or reduced, in buildings during periods when they



HEATING AND COOLING WITH SUNSHINE—Workmen at Marshall Space Flight Center are shown as they proceed with the construction of an A-frame roof over three house trailers parked together to simulate a residence that will be heated and cooled by thermal energy from the Sun.

were not in use. Lighting was reduced wherever possible throughout the Center, and parking lot lights were turned off at 9 p.m.

Vehicles traveling on MSFC-controlled roads were limited to 50 mph.

A carpool program was well organized. Effective Feb. 25, Dr. Rocco A. Petrone, MSFC Director, announced that regular work shifts for Center personnel would be reduced from four to two each day to make it more convenient for many employees to join carpools. Prizes and other recognition were used as incentives. Fifteen carpool assistance boards were located throughout the Center to assist employees, both MSFC and contractor, in making direct contact for suitable arrangements. Other steps included establishment of reserved parking for carpools and the opportunity for voluntary participation in the Department of Transportation Computerized Carpool Matching System.

Further energy conservation is represented by a mobile "country store," a van equipped with bins containing nearly 300 supply items to supply needs all over the Center. It has made possible reduction of supply stores from five to one.

MISSISSIPPI TEST FACILITY

The Mississippi Test Facility, where several agencies are involved in space and environmental activities, started its energy conservation program more than a year ago and already has achieved significant results.

The MTF is cooperating to the fullest with the Mississippi Coast Association of Federal Administrators' coast-wide program to coordinate energy conservation with all agencies located in the three-county area.

Because of the very nature of its work—investigating and taking inventory of precious natural resources—the MTF foresaw and began its program before the "energy crisis" became news.

Last July, the MTF was directed to reduce energy use by 8.1 per cent below the previous year's consumption. From that month through September, a comparative reduction of 12.3 per cent in BTU consumption was recorded.

The reduction in the period from October through December was 25.6 per cent, and the projected usage rate from January through March indicates a 20.2 per cent drop. Assuming that all current conservation measures are continued successfully, with a 15 per cent cut in consumption through June, the overall reduction rate for the 12-month period will be 16.5 per cent—more than twice the original goal.

Some of the reduction measures that have been employed include cutting down heat in buildings; restricting most operations to one shift; reducing lighting levels, particularly in non-critical areas; reducing services in selected areas; lowering vehicle mileage and enforcing a 5 p.m. closing of all areas not on two or more shifts; and using bicycles in areas where feasible.

In addition to directing conservation efforts on the site, resident agencies are encouraging employees to apply conservation measures at home and to join carpools. The average number per car of employees arriving at work has risen from 1.9 in early December to three in the second week of January. It is estimated that this increase in carpool participation will save 220,000 gallons of gasoline per year.

DR. KAPRYAN IS OPTIMISTIC ABOUT SOLVING ENERGY CRISIS

But Tells Detroit Audience Solution Will Depend Upon "Judicious Management"

"We will solve the energy crisis."

This was the prediction that Dr. Walter J. Kapryan, Director of Launch Operations at Kennedy Space Center, made before the Engineering Society of Detroit on Feb. 20.

The occasion was a banquet at which he was presented the Society's "Gold Award," given annually to the person selected as the outstanding engineer from that area. Dr. Kapryan is a native of Detroit.

As principal speaker at the banquet, he used as a topic "Engineering — Our Greatest Energy Source." In his discussion, he said the President's Project Independence, designed to make the nation self-sufficient in fulfilling its energy needs by 1980, will be a success because it must be a success. But he warned that it would not happen overnight.

"Much dedicated effort will be required," he explained. "We, the technical community, of necessity, will be the basic contributor. Our techni-

cal solutions, however, will have to be tempered by the sober judgment of judicious management. Our resources must be channeled in order to effect expeditious and cost effective solutions."

He estimated that it will take literally billions of dollars to solve the energy problem and cautioned that, with this money available, sound leadership will be required to preclude indiscriminate and wasteful activity.

"If leadership is not exercised," he added, "then our solutions may well create many problems for our society, and then other massive measures and programs will be necessary. Thus the cycle may well repeat itself again and again as has historically been the case."

He recalled that elements of the technical community have for many years been working on the energy problem, though on a low key basis. The effort, he said, was aimed at developing alternate sources of energy, those not based on petroleum products.

Solar Energy Not New

He listed first solar energy, recalling that one of the earliest recorded applications of this source was in 212 B.C., when Archimedes reportedly set fire to an attacking Roman fleet by directing concentrated rays from solar collectors. During the last century, he added, solar ovens have been used for cooking, solar stills have turned salt water into fresh water, and solar water heaters have been used in homes.

"But these benchmarks were sporadic and insignificant at best," he pointed out. "In recent years, solar energy researchers have been relegated to obscurity since the public and industry refused to abandon cheap seemingly inexhaustible fossil fuels—that is, until the appearance of our present energy crisis. Industry hasn't developed economic solar energy systems because it believed the public wasn't interested in them. The public, on the other hand, has had other priorities to deal with in recent years and, characteristically, has looked to industry for innovations."

He mentioned that industry had been slowed in its efforts to find new energy sources by high cost. Twenty-five years ago, he reminded, the Federal Government was optimistic about solar energy applications and predicted that, by 1975, there would be about 13 million American homes heated by this method. As it is, only a dozen or so homes use this source.

The present energy crisis, he said, has caused old concepts to be dusted off, and added:

"But engineers caution that, despite new unprecedented funding and expanded research, the adaptation of solar energy will not solve the immediate energy crisis. These visionaries are looking ahead 20 to 30 years, when solar energy applications will be more widely accepted."

Windmill Has Problems

In discussing the return of the windmill to ease the energy shortage, he said one of the most challenging problems facing experimenters are the methods to store energy in anticipation of periods without sufficient wind.

Dr. Kapryan reported that NASA still is experimenting with the nuclear rocket, which, he said, some day may ferry astronauts to and from the planet Mars in 60 days, greatly reducing the nearly one-year time frame required for a one-way journey by present-day unmanned probes.

"The frontiers of technology," he concluded, "have pushed forward several quantum steps in the last few years. We, the engineers, can no longer afford the luxury of narrow-banded technical vision. The impact on society is too great. We must factor into our equations the parameters of human relations, our environment, the planet Earth and the solar system to a much greater degree than ever before.

"This I feel is our true challenge. I am confident that we will be equal to that challenge. We merely have to make up our minds, for our minds are our greatest resource. We are limited only by our intelligence, desire and imagination."

SPACE EDUCATION PROGRAM

More than 40 space lectures and demonstrations were presented by NASA and Marshall Space Flight Center personnel in the Jackson, MS, area during a three-week educational program that began on Feb. 18.

During this concentrated educational effort, planned and coordinated by MSFC and school officials of Mississippi and the city of Jackson, students, teachers and the general public were informed of accomplishments in the nation's space program. In addition to daily lectures at student assemblies, presentations were made to many civic and public groups, including television audiences.

MYERS LEAVES NASA

Dale D. Myers, who has headed all manned space flight programs since January, 1970, has resigned from NASA, effective March 15, and will rejoin Rockwell International Corporation as president of a new aircraft group to be created with headquarters in Los Angeles.

As Associate Administrator for Manned Space Flight, he headed one of five major research and development offices at NASA Headquarters and was responsible for the planning, direction, execution and evaluation of overall manned space flight activities.

William C. Schneider, Director of the recently concluded Skylab program, has been named Acting Associate Administrator for Manned Space Flight.

"We are sorry to see Dale Myers resign," Dr. James C. Fletcher, NASA Administrator, said, "but we can appreciate his desire to return to private business. Dale leaves us in his debt. During his four years as head of manned space flight, the Apollo and Skylab programs have been completed successfully, the experimental joint test program with the Soviet Union is nearing reality, the Space Shuttle is clearly and firmly established as our next major manned effort in space, and our European partners have agreed to develop the important Spacelab element of the Shuttle."

Myers is a Fellow of the American Institute of Aeronautics and Astronautics and a Fellow of the American Astronautical Society. In February, 1969, he was awarded the NASA Certificate of Appreciation for his contributions to the Apollo 8 Moon-orbiting flight, and in September, 1969, received the NASA Public Service Award for his contributions to the success of the Apollo 11 lunar landing mission. In February, 1971, he was awarded the NASA Distinguished Service Medal for his contributions to the continuing success of the Apollo program.

Schneider, as Skylab Program Director since December, 1968, directed the development and flight operation of the nation's first manned experimental space station. He saw the program come to a successful operational conclusion Feb. 8 with the splashdown of the third and final astronaut crew to visit the Earth-orbiting research facility. NASA's highest honors have been accorded him for his leadership in the Skylab, Apollo and Gemini programs.

NEW WPPR PROGRAM SPREADS THROUGHOUT SPACE CENTERS

Langley Leads Way in Developing Work Planning and Progress Reviews

A program started little more than a year ago to provide employees with a clear understanding of their assignments in NASA, officially referred to as Work Planning and Progress Reviews (WPPR), is taking hold throughout the agency.

This is the report of Gwynne R. Berry, Employee Relations Specialist at NASA Headquarters.

"WPPR is a simple process, but doing it is another matter," he explains. "It involves discussions between supervisor and employee to identify what work is to be done and to develop a work plan. Also, it calls for periodic meetings between supervisor and employee to jointly review progress that has been made.

"In effect, it is a two-way dialogue for the exchange of information between supervisors and employees, a systematic communication process that supports employees in their natural desire to succeed on the job. Emerging from it quite often, we have noticed, are a genuine willingness and desire on the part of both employees and supervisors to give it a fair trial."

It is not a new system. Some major industrial firms already had adopted it. General Electric Co. is believed to have been the first to identify it as a process and to devote research to it. The results of its studies were so encouraging that its department heads used it on a trial basis and found convincingly that it would work.

Of the NASA installations, Langley Research Center has led the way in putting the program into effect. But other Centers have shown interest in getting it started, according to Berry, and have undertaken initial training of supervisors.

Program Becomes Official

The program became official in the space agency on Oct. 13, 1972, when Dr. George M. Low, NASA Deputy Administrator, signed the directive—NPD 3400.1. The preceding January he had asked the

Personnel Management Review Committee, headed by Dr. John E. Duberg, to concentrate its efforts on performance review as a part of performance evaluation. Performance review is defined as "the discussion between manager, or supervisor, and their employees covering work objectives and standards, future work requirements, and developmental and training activities."

In its report, submitted the following May 1, the Committee said:

"From our appraisal of performance review, we are convinced that it is a valuable process in dealing with the human resources of NASA. It is well worth the time and effort needed and will help to assure greater satisfaction among employees and increased production levels. . . . Furthermore, it is a most important form of communication among the people of NASA."

Its study had turned up several problems which it concluded kept performance review from being a useful management tool. First of all among these, it found that performance review was generally confused with performance evaluation required by Civil Service regulations, and, thus, was sometimes conducted in a perfunctory and meaningless manner. Moreover, managers and supervisors seemed unfamiliar with how best to handle the process and were embarrassed because it seemed to put them in the role of a judge.

"In view of this," the Committee stated, "it is obvious that our training of supervisors and managers has not given adequate coverage to this area of personnel management."

The Committee cited three conditions as fundamental to the success of the review process: (1) both supervisor and employee must be familiar with the objectives involved and give adequate thought to each review; (2) the employee must know what is expected of him; and (3) there must be a genuine concern on the part of the Supervisor for the employee's interests and aspirations.

"The end result," the Committee advised, "should be greater incentive on the part of the employee to perform because he is informed and has a stake in the performance of work he has had a hand in developing. The supervisor gains from having a broader knowledge of what his employee is doing."

Effect of Directive

At the time the directive went into effect, it was expected to:

1. Provide employees with a clear understanding of their assignments and responsibilities.

2. Have employees participate actively in the development and review of their individual work objectives and plans.

3. Have supervisors assist their employees in developing individual work objectives and plans.

4. Hold employees accountable for the responsibilities and work assigned.

5. Pinpoint developmental needs of individual employees.

6. Have employees improve performance where improvement is within their capability, and develop skills relating to the current assignment and possible future jobs.

The directive specified that supervisors at all levels should meet as necessary with each employee on an individual basis to review work progress, acknowledge achievements, discuss and solve problems, identify developmental needs, and discuss work plans and objectives. At least one such meeting should be held each year, it stated, and work planning and progress review sessions should be separate from discussions of official performance ratings.

The NASA Director of Personnel soon sent representatives from his office to every Center and to Wallops Station to discuss efforts to put the policy into effect and provide advice and assistance. A "soft sell" approach was used—WPPR is nonbureaucratic, no forms are specified, and there is no agency reporting requirement.

It was pointed out that WPPR was, in a sense, the continuation of a process that most supervisors already used to some degree. From it could come definite advantages—smoother work flow, improved working relationships with and between employees, more confidence that work was being done properly, and a better factual basis for judgments on work-related matters.

Langley Takes Lead

Langley Research Center, where several conditions encouraged a favorable response, immediately ran with the ball. Since 1971, its Materials Division had been holding work plans and progress review discussions. Moreover, the Center had developed goals and objectives that captured major tasks and goals of an immediate and three-to-five-year projection by organizational elements, and this provided an effective road map for WPPR discussions. As a further advantage, William L.

(Bill) Williams, the Assistant Personnel Officer, who was to develop and present the briefing for all supervisors, was also a part-time professor in a local university's graduate management program.

At an early date, a copy of the directive was issued to every Langley supervisor, along with a letter outlining details for a series of briefings. By December, the Materials Division was conducting a survey of professional employees and supervisors to obtain practical experiences, problems, and successes encountered.

In February, briefings were given to divisions individually for their supervisors, with ample time allowed for questions. Two weeks later, each division was revisited to obtain the timetable it had worked out to implement WPPR.

Follow-up assistance was provided by Bill Williams throughout the spring. In June, a leading management consultant presented a seminar on industry experiences related to WPPR. That same month, a student from Northwestern University began interviews and distributed questionnaires to aid with a report on WPPR progress locally. The entire program was so well conducted and supported by top management at the Center that Langley soon began getting inquiries as to the methods it had used.

The Langley Center Director conducts WPPR sessions with each of his directorate heads. These have been recognized as being instrumental in getting WPPR acceptance and confidence throughout the various organizations at Langley.

In discussing the program, Berry emphasizes that it is viewed as a long-term and not a hurry-up-and-get-it-over-with proposition.

"It probably will take five years to institutionalize the philosophy of WPPR," he added. "Our strategy calls for exposure of the program—what it is and why it should be used. We will stress supervisory training. And we will focus on management orientation.

"We are convinced we are on the right track. Research studies and industrial applications have demonstrated that, through WPPR, employees will do their best work and will obtain greater job satisfaction, and that is what we want."

Definitive answers as to whether Mercury has an atmosphere and how hot is its surface are expected to be supplied by two scientific instruments aboard Mariner 10, scheduled to fly by the planet closest to the Sun March 29.

FRC WORKER HONORED—The Meritorious Service Medal, one of the highest peacetime honors given by the U.S. Army, was presented to former Army Captain Michael F. Mitzel for his work while assigned to Flight Research Center from 1970 to 1973. Shown here with his three-year-old son, Danny, Mitzel was honored for his work in computer system analysis and programming that made a substantial contribution to the success of the YF-12 aerostructure research program conducted at the Center.

KERWIN DISCUSSES MEDICAL ASPECTS OF SKYLAB MISSION

Tells House Subcommittee People Act in Orbit as on Earth

Dr. Joseph P. Kerwin, Science Pilot on the first Skylab mission and the first medical doctor to enter space, appeared as a witness before the Subcommittee on Manned Space Flight of the House of Representatives during recent budget hearings. His testimony follows:

I suppose that I've been asked to give testimony partly as one of the few physicians left who make house calls, but mostly to add the honest appraisal of one who's been there to the statement by our agency that man can function effectively in the weightless environment.

There's a tendency for skeptics to think that spaceflight is more stressful and difficult than we've found it to be, and that it will always be something of a stunt. Now, I will not pretend that our crew wasn't very happy to come home after

28 days—or Jerry Carr's crew after 84. Our environment did lack some of the comforts of home, but it's no stunt. The Skylab program has given us enough evidence to assess very accurately the effect of weightlessness on human performance. I would like to give my assessment.

First, what are the medical symptoms of weightlessness? In order to describe these briefly, I have pretended that the three of us on Skylab were one man, and have put together a composite medical history.

On the 13th of June, 1973, which was the 20th day of the Skylab 1 mission, I was called from my busy practice to examine a patient who had the following story to tell: his chief complaint was an unexplained weight loss of about six and a half pounds. The story of his illness was as follows:

Three weeks ago, he was minding his own business on Launch Pad 39 at Cape Kennedy when he was suddenly launched into a circular orbit around the Earth. The resulting state of free fall has continued until the present. There was an initial period of somewhat decreased appetite which lasted three or four days. On weighing himself on the fifth day, he had lost three and a half pounds. Since that time, his food intake has returned to essentially normal and he feels well. But an additional three pounds have been lost at the end of three weeks.

Abnormal Sensations

On questioning the patient about his symptoms, I got the following answers: He describes a feeling of well-being. He says that his appette and thirst are normal, and that he could eat more food if it were necessary. He says that he especially craves meat and ice cream. He has noted the following abnormal, for him, sensations:

1. A feeling of fullness in the head, as though he had a cold, which he does not. This has been continuous since the very first minutes of his arrival in weightlessness, although it's less noticed now.

2. He tends to assume a peculiar posture. When he is relaxed, his neck extends and moves backward, his shoulders and elbows flex 20 or 30 degrees. The same is true of the hips and knees, and the shoulders tend to rise up toward his ears. This is uncomfortable at first, and it is a little annoying when he attempts, for instance, to read a book down on his lap. But he has gradually become accustomed to it and has stopped attempting to pull his shoulders down consciously because it is no good. They must go right back up as soon as he relaxes.

3. He has noted a tendency to become sleepy, and even to take cat naps when he is motionless and relaxed. For instance, during the resting phase of the various medical experiments this happened. Frequent exercise is desired to restore a feeling of vigor and alertness.

He reports that distant sounds appear to be more difficult to hear than they are on the ground. In the nose and throat area, he said that he and his fellow crewmates were quite hoarse during the first week or 10 days of the flight. He attributes this to the fact that they had to shout in order to be heard across the distances involved in the workshop. They gradually gave up on shouting and began using the intercom system instead, and the hoarseness has gone away.

He also has noticed in himself and in his crewmates a peculiar nasal quality to the voice. This was immediate and has been continuous.

In the gastrointestinal system, the only abnormal finding is that it is very difficult to belch, to pass gas out through the mouth. One does swallow a great deal of gas, and one finds that the GI system processes it downward very effectively with great volume and frequency.

No Motion Sickness Symptoms

When asked about the vestibular system, this particular individual reported that there were no symptoms of motion sickness. There was, as reported previously, the slight decrease in appetite. Along about the eighth or ninth day of the mission, the patient decided at that time that he felt better than he had during the first two or three days. But it was strictly hindsight. If you had asked him how he felt on the third day, he would have said that he felt fine.

Since that time, he has been virtually immune to motion sickness. And he's discovered that his sensations of up and down and his method of moving about are quite different from on the ground. With no gravity, he has no idea where the Earth is, unless he sees it out of the window. But he has to have some system of up, down, right, left, and so forth so that he can tell his eyes and hands where to go. And he does. He always feels that he is upright, no matter which way he's facing in the spacecraft. If he's standing on the floor of a compartment, the floor is "down." If he's standing on the ceiling, it's "down," and the floor is "up". It's an Alice-in-Wonderland sort of feeling, unexpected and rather pleasant. But he soon

learns that he'd better not close his eyes, or he quickly and completely gets lost. Without vision in weightlessness, one has no idea where anything is—there is no outside world.

In the cardiovascular area, he has no complaints. His only difficulty has been during the lower body negative pressure exercise which is a great deal more difficult to complete in weightlessness than it was on the ground before the flight. The pulse rate is higher, the blood pressure is somewhat lower, and there is an increased tendency towards fainting on some of the runs. This is the one medical experiment that is subjectively stressful in flight. However, he is not able to say that as the days go on the tests become more stressful. The distribution seems to be random. One day will be better, one day will be worse, but there is no clear-cut trend.

Sleep Quality Good

The quality of sleep has been good, although it seems to have taken him a little longer to get to sleep, at least at first. He feels this is strictly a subjective comfort thing, that he is not able to arrange his limbs in the same way that he does on the ground.

I won't say too much about the physical examination, except that doing one in-flight is quite feasible. The findings were normal except for some minor points which are of interest to physicians. My diagnosis at the time was that the patient was healthy and not under significant stress. Subsequent events have not changed it. The weight loss, despite a healthy appetite, and the exaggerated response to lower body negative pressure, I could not explain in flight. They are signs of some rather fascinating adjustment that the body makes to zero gravity.

Let's talk about performance for a moment. What did our job really consist of? Our tasks ran the gamut from really complex science like solar physics, where we were given a lot of decision-making latitude, to Earth resources, where we were used as timing and tracking and target-finding devices, to being safety monitors (and guinea pigs) on the medical experiments. We were also technicians, clerks, errand boys, and cab drivers (getting there and getting back). The ruling principle was: can the crew do it better, or more cheaply, or with more versatility than a machine?

Day's Activities Mapped

Every morning we picked up 20 feet of teleprinter tape which constituted our instructions for the day. A large team of people had worked through the night preparing the details, and many of the decisions and calculations were already made—things like, "The weather is suitable for an Earth resources pass over California, the maneuver time is 11:05 and 30 seconds," etc.—or, "Active Region 35 on the Sun is showing signs of flaring, so look at it with the following sensors"—or, "The pilot didn't eat his bread yesterday, so he'll need a calcium pill."

Each person cut off his share of these detailed instructions, tucked them away into his personal notebook, and began to figure how he'd carry them out. The first thing to look for were time critical events—things that had to be done at a precise time or lose the data. Often a portable alarm clock was set as a reminder. Then we looked for things that required advance setup or preparation, and decided where to fit that in; things that would run overtime if we weren't careful, could we get an early start on these, and what could we drop out if something did run late? Some items were solo, some required two or even all of us.

It takes a while for a crew to fall into a routine like this, neatly dovetailing with each other. When you rush "downstairs," late for a medical experiment, and find that your partner has already done your part of the pre, you know it's working. You know you've got a smooth and very versatile machine, almost infinitely reprogrammable, not error free, but self-correcting, learning from its mistakes. A machine that gets the giggles late at night over the ice cream and strawberries, and occasionally looks out the window when it could be writing the log, but which lives and is replenished by these things, better than a machine is by its voltages and lubricants, and will be ready to go again tomorrow.

Real teamwork is memorable. And in space, it's just the same. People perform up there the way they do down here. Their capabilities, individually and collectively, and their potential, and their weaknesses are the same. And when we're ready to dispense with people on Earth, we can do it in orbit and the computers can talk to each other forever.

Hopefully, space stations will be a reality at some time during the next human generation.

28 days—or Jerry Carr's crew after 84. Our environment did lack some of the comforts of home, but it's no stunt. The Skylab program has given us enough evidence to assess very accurately the effect of weightlessness on human performance. I would like to give my assessment.

First, what are the medical symptoms of weightlessness? In order to describe these briefly, I have pretended that the three of us on Skylab were one man, and have put together a composite medical history.

On the 13th of June, 1973, which was the 20th day of the Skylab 1 mission, I was called from my busy practice to examine a patient who had the following story to tell: his chief complaint was an unexplained weight loss of about six and a half pounds. The story of his illness was as follows:

Three weeks ago, he was minding his own business on Launch Pad 39 at Cape Kennedy when he was suddenly launched into a circular orbit around the Earth. The resulting state of free fall has continued until the present. There was an initial period of somewhat decreased appetite which lasted three or four days. On weighing himself on the fifth day, he had lost three and a half pounds. Since that time, his food intake has returned to essentially normal and he feels well. But an additional three pounds have been lost at the end of three weeks.

Abnormal Sensations

On questioning the patient about his symptoms, I got the following answers: He describes a feeling of well-being. He says that his appette and thirst are normal, and that he could eat more food if it were necessary. He says that he especially craves meat and ice cream. He has noted the following abnormal, for him, sensations:

1. A feeling of fullness in the head, as though he had a cold, which he does not. This has been continuous since the very first minutes of his arrival in weightlessness, although it's less noticed now.

2. He tends to assume a peculiar posture. When he is relaxed, his neck extends and moves backward, his shoulders and elbows flex 20 or 30 degrees. The same is true of the hips and knees, and the shoulders tend to rise up toward his ears. This is uncomfortable at first, and it is a little annoying when he attempts, for instance, to read a book down on his lap. But he has gradually become accustomed to it and has stopped attempting to pull his shoulders down consciously because it is no good. They must go right back up as soon as he relaxes.

3. He has noted a tendency to become sleepy, and even to take cat naps when he is motionless and relaxed. For instance, during the resting phase of the various medical experiments this happened. Frequent exercise is desired to restore a feeling of vigor and alertness.

He reports that distant sounds appear to be more difficult to hear than they are on the ground. In the nose and throat area, he said that he and his fellow crewmates were quite hoarse during the first week or 10 days of the flight. He attributes this to the fact that they had to shout in order to be heard across the distances involved in the workshop. They gradually gave up on shouting and began using the intercom system instead, and the hoarseness has gone away.

He also has noticed in himself and in his crewmates a peculiar nasal quality to the voice. This was immediate and has been continuous.

In the gastrointestinal system, the only abnormal finding is that it is very difficult to belch, to pass gas out through the mouth. One does swallow a great deal of gas, and one finds that the GI system processes it downward very effectively with great volume and frequency.

No Motion Sickness Symptoms

When asked about the vestibular system, this particular individual reported that there were no symptoms of motion sickness. There was, as reported previously, the slight decrease in appetite. Along about the eighth or ninth day of the mission, the patient decided at that time that he felt better than he had during the first two or three days. But it was strictly hindsight. If you had asked him how he felt on the third day, he would have said that he felt fine.

Since that time, he has been virtually immune to motion sickness. And he's discovered that his sensations of up and down and his method of moving about are quite different from on the ground. With no gravity, he has no idea where the Earth is, unless he sees it out of the window. But he has to have some system of up, down, right, left, and so forth so that he can tell his eyes and hands where to go. And he does. He always feels that he is upright, no matter which way he's facing in the spacecraft. If he's standing on the floor of a compartment, the floor is "down." If he's standing on the ceiling, it's "down," and the floor is "up". It's an Alice-in-Wonderland sort of feeling, unexpected and rather pleasant. But he soon

learns that he'd better not close his eyes, or he quickly and completely gets lost. Without vision in weightlessness, one has no idea where anything is—there is no outside world.

In the cardiovascular area, he has no complaints. His only difficulty has been during the lower body negative pressure exercise which is a great deal more difficult to complete in weightlessness than it was on the ground before the flight. The pulse rate is higher, the blood pressure is somewhat lower, and there is an increased tendency towards fainting on some of the runs. This is the one medical experiment that is subjectively stressful in flight. However, he is not able to say that as the days go on the tests become more stressful. The distribution seems to be random. One day will be better, one day will be worse, but there is no clear-cut trend.

Sleep Quality Good

The quality of sleep has been good, although it seems to have taken him a little longer to get to sleep, at least at first. He feels this is strictly a subjective comfort thing, that he is not able to arrange his limbs in the same way that he does on the ground.

I won't say too much about the physical examination, except that doing one in-flight is quite feasible. The findings were normal except for some minor points which are of interest to physicians. My diagnosis at the time was that the patient was healthy and not under significant stress. Subsequent events have not changed it. The weight loss, despite a healthy appetite, and the exaggerated response to lower body negative pressure, I could not explain in flight. They are signs of some rather fascinating adjustment that the body makes to zero gravity.

Let's talk about performance for a moment. What did our job really consist of? Our tasks ran the gamut from really complex science like solar physics, where we were given a lot of decision-making latitude, to Earth resources, where we were used as timing and tracking and target-finding devices, to being safety monitors (and guinea pigs) on the medical experiments. We were also technicians, clerks, errand boys, and cab drivers (getting there and getting back). The ruling principle was: can the crew do it better, or more cheaply, or with more versatility than a machine?

Day's Activities Mapped

Every morning we picked up 20 feet of teleprinter tape which constituted our instructions for the day. A large team of people had worked through the night preparing the details, and many of the decisions and calculations were already made—things like, "The weather is suitable for an Earth resources pass over California, the maneuver time is 11:05 and 30 seconds," etc.—or, "Active Region 35 on the Sun is showing signs of flaring, so look at it with the following sensors"—or, "The pilot didn't eat his bread yesterday, so he'll need a calcium pill."

Each person cut off his share of these detailed instructions, tucked them away into his personal notebook, and began to figure how he'd carry them out. The first thing to look for were time critical events—things that had to be done at a precise time or lose the data. Often a portable alarm clock was set as a reminder. Then we looked for things that required advance setup or preparation, and decided where to fit that in; things that would run overtime if we weren't careful, could we get an early start on these, and what could we drop out if something did run late? Some items were solo, some required two or even all of us.

It takes a while for a crew to fall into a routine like this, neatly dovetailing with each other. When you rush "downstairs," late for a medical experiment, and find that your partner has already done your part of the pre, you know it's working. You know you've got a smooth and very versatile machine, almost infinitely reprogrammable, not error free, but self-correcting, learning from its mistakes. A machine that gets the giggles late at night over the ice cream and strawberries, and occasionally looks out the window when it could be writing the log, but which lives and is replenished by these things, better than a machine is by its voltages and lubricants, and will be ready to go again tomorrow.

Real teamwork is memorable. And in space, it's just the same. People perform up there the way they do down here. Their capabilities, individually and collectively, and their potential, and their weaknesses are the same. And when we're ready to dispense with people on Earth, we can do it in orbit and the computers can talk to each other forever.

Hopefully, space stations will be a reality at some time during the next human generation.

Five days before our crew was launched, we went outside in the evening to watch Skylab pass overhead. It moved pretty rapidly, but it shone as bright and steady as a star, and we knew it was going to be up there for a long time. To me, it was as though we were going up to homestead a new state—as though that vehicle were the 51st star on the flag. The territory is still open, and there's a lot to be done up there. We'll be ready when you are.

ERTS MAKES PROSPECTING FOR ORE, WATER EASIER

Scientists Spot Promising Sources in Pictures Relayed by Satellite

ERTS-1, circling the Earth in a 907-kilometer (560-mile) orbit every 103 minutes, is making it possible for scientists from Jet Propulsion Laboratory and the United States Geological Survey literally to prospect for mineral and water deposits on Earth.

Using multispectral photograph and computer instead of pick and shovel, the prospector-scientists already have clarified pictures to show where ore and water might lie buried in two areas of the Southwest. The technique they use was devised by Dr. Alexander Goetz and Fred Billingsley of JPL and was first employed to improve early spacecraft pictures of the Moon and Mars.

Already successfully detected are surface manifestations of known mineral deposits—mainly limonite (iron oxide)—near Goldfield, NV, and indications of promising underground water supplies in northern Arizona near Flagstaff and the Grand Canyon.

Goldfield, just south of Tonopah, NV, was selected as a primary test area. A prolific gold-mining region 60 years ago, it has virtually depleted its once-rich deposits. The slide toward ghost-town status, scientists point out, may not be arrested by the ERTS photos, but the area could provide a mother-lode of scientific information for locating deposits elsewhere.

Three areas of Arizona have been geologically scanned for water. These are the Verde Valley, the Shivwits Plateau northeast of Lake Mead, and the Coconino Plateau between Highway 66 and the Grand Canyon. Pictures have revealed faults and fractures, some seen for the first time, which Dr. Goetz says "may be important in locating drill sites for deep ground water." These deposits may vary in depth from 40 to 2,000 feet.

A team that began exploratory drilling on an ERTS-indicated water hole 10 miles south of the Grand Canyon struck a water-saturated rock layer at about 40 feet. This is recognized as good news for ranchers who have to truck in water for their cattle and ration supplies from the few shallow wells in the Coconino area. Moreover, satellite

FRC VISITORS FROM AVIATION WEEK—Bob Hotz (second from right), editor of Aviation Week magazine, and Don Fink (second from left), West Coast writer for the publication, were recent visitors at Flight Research Center and were briefed on current programs and future plans. Taking part in the briefing and tour were Jim Adkins (left), Deputy Director, Research Projects, and Gary Krier, Project Pilot for FRC's Digital Fly-by-Wire Program.

maps show that the old volcanic lava beds on the surface of the Colorado Plateau are fractured in a pattern indicating possible access to a system of underground rivers.

Besides NASA and the Geological Survey, other government agencies involved in the ERTS project include the Environmental Protection Agency, Departments of Commerce and Agriculture, and the U.S. Army Engineers.

STANDARDIZED SEPS STUDY IS NOW UNDER WAY AT MSFC

Planned as Important Part of Space Transportation System for Earth-Orbital Missions

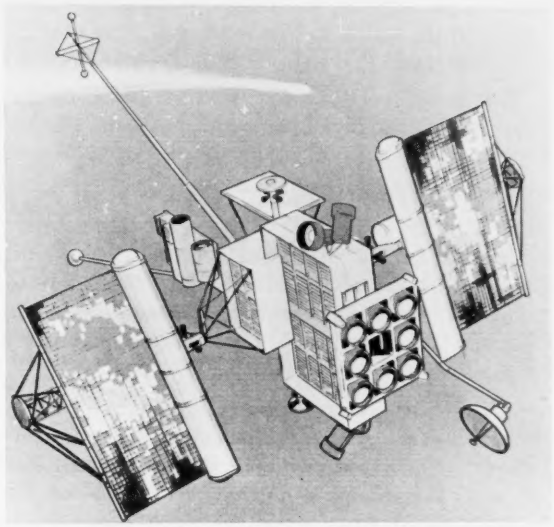
A standardized Solar Electric Propulsion Stage (SEPS) that could become an important part of a space transportation sysem for a wide range of payloads for planetary and Earth-orbital missions is now under study at Marshall Space Flight Center.

SEPS is one of several concepts under consideration for the application of solar electric propulsion. Another approach is to employ SEPS as an integrated spacecraft propulsion subsystem. Or an attachable SEPS module could be developed that would have growth capability to a stage, but could provide solar electric propulsion for planetary spacecraft until the full SEPS stage is developed.

The SEPS will use high power solar arrays and electric thrusters and will be designed to be compatible with the Space Shuttle and Space Tug. Current studies assume a slow flyby of Comet Encke, to be launched by a Titan/Centaur in 1979, as the first SEPS mission. Application of an attachable SEPS module to a Mariner spacecraft for this mission is also being studied.

Essentially, the SEPS consists of a modular electric propulsion subsystem and a common structure which houses its operating subsystems. It will be capable of accepting modules such as a docking subsystem for Earth-orbital missions or a science package for planetary missions. In contrast to the attachable SEPS module concept, which provides propulsion only and depends on spacecraft subsystems for all other functions, the SEPS could provide such functions as telemetry, attitude control, data handling, etc. The length of the common stage is about 8.5 feet for planetary missions and 10 feet for Earth-orbital applications.

The thrusters, using ionized mercury as a propellant, will have a total thrust of about .03 of a pound each and will be capable of firing continuously for 10,000 hours, or about 14 months. The nominal specific impulse is 3,000 seconds, which is approximately seven times greater than that obtainable with present chemical propulsion.



PLANNING FOR COMET ENCKE IN 1979—This is a concept of the Solar Electric Propulsion Stage (SEPS) that NASA is planning to have in readiness for a slow flyby of Comet Encke in 1979. Observation of the comet has been considered as the first mission of SEPS.

ALAN SHEPARD HONORED

The current volume of The Hereditary Register of the United States of America has been dedicated to Rear Admiral Alan B. Shepard, Jr., USN, Chief of the Astronaut Office at Johnson Space Center.

A formal reception to honor Admiral Shepard and the national officers of the hereditary societies of the nation will be held at the Washington Club in Washington, DC, the night of April 13.

The 1972 and 1973 editions of the publication were dedicated, respectively, to the late President Dwight D. Eisenhower and the late General of the Army Douglas MacArthur.

Approximately 100 educators from Tidewater, Virginia, and as far away as the Richmond area attended an aerospace education conference hosted by Langley Research Center Feb. 25.

SKYLAB CREDITED WITH MARKING START OF PROFITABLE SPACE ERA

President Describes Effort As "New Definition of Our Own Destiny"

At a press conference held at Johnson Space Center after its final crew splashed down, Skylab was pictured as marking the beginning of an era in which space will be made into "another dimension"—one that man will use profitably.

This was the estimate of William C. Schneider, Director of the Skylab program.

"Man is going to live and work up there," Schneider predicted. "And with the Shuttle, we're going to make that easier than it was on Skylab."

Shortly before Schneider's evaluation of the program, Dr. James C. Fletcher, NASA Administrator, read the following message from President Nixon, which he said had been relayed to the ship in the Pacific that had rescued the crew:

"On behalf of the American people, I salute the third crew of Skylab astronauts on your safe return to Earth and on your successful completion of man's longest space journey. Your mission has brought to an end one of the most scientifically productive endeavors in the history of human exploration.

"Skylab now joins the ranks of the *Santa Maria*, the *H.M.S. Beagle*, the *Spirit of St. Louis* and the *Eagle*. Each of these great vehicles has carried us beyond the contemporary limits of human knowledge into a new comprehension of our own possibilities and a new definition of our own destiny. We welcome you home, and we salute you and all your predecessors who have launched us on this great adventure."

After reading the message, Dr. Fletcher commented that "everything that we have done in the Skylab program has been necessary for future progress in space," adding: "And the Skylab experience has confirmed that we are really on the right track in proceeding to develop the Space Shuttle and its Spacelab manned module for use in the 1980s and 1990s."

He said Skylab has demonstrated that this nation is capable of conducting broader and more useful beneficial activities in space that directly relate to Earth.

"In a very real sense," he continued, "Skylab can be considered a turning point, for while it was basically an experimental station, it nevertheless possessed many qualities and ingredients that will characterize operational missions for the future. It has moved the space program from the realm of the spectacular into a new phase that can be characterized possibly as almost businesslike, if not yet quite routine.

". . . The investment in Skylab has contributed to an orderly transition from the Apollo era of the '60s to the Shuttle Spacelab era of the '80s, and has continued U.S. leadership in manned space flight. We have clearly demonstrated that man can perform valuable services in Earth orbit as observers, scientists, engineers, and repairmen. Skylab has given us a wealth of new information about the dynamic processes of the Sun and how this affects us here on Earth."

Pointing out that Skylab has provided new evidence of the value of Earth observations from space and stimulated interest in international cooperation, he said, "We will be living with Skylab achievements for a long, long time."

In a statement made at the beginning of the questioning period, Program Director Schneider revealed that he had received a great number of questions in the week preceding as to the greatest achievement of Skylab.

"As far as I'm concerned," he said in reply, "the greatest achievement was to prove beyond a doubt that there is no limit in our space research, that, just like anything else America sets out to do, the limit is only our resolve; not our ability to do work, not the ability of men to work, and not our technical knowledge."

In answer to a question as to how long the workshop will be expected to remain aloft, he said that, after certain tests, it would be placed in what is termed a gravity gradient mode, the lights and switches will be turned off, and it will be allowed to drift, perhaps 10 years or so. Currently, he added, there are no active plans to revisit it.

FILM ACTIVITY

The recently released NASA film "Mars—The Search Begins" was shown at a press premier in the Whitney Museum of American Art, New York City, on Feb. 20. Approximately 100 members of the press, film representatives and diplomats from the United Nations attended. A similar function is scheduled to be held at the Motion Picture Association in Washington, DC.

SPACE PROCESSING SYMPOSIUM

The third Space Processing Symposium will be held at the Marshall Space Flight Center April 30 to May 1. Early results of materials processing experiments performed on Skylab will be presented by the principal investigators. Other papers will cover future flight opportunities and ground-based research studies for space processing.

APOLLO 16 ON DISPLAY

MSFC Director Rocco A. Petrone and Astronaut Owen Garriott represented NASA on Feb. 4 when the Apollo 16 command module was turned over to the Alabama Space and Rocket Center for display. The spacecraft, which traveled nearly 500,000 miles in April, 1972, will occupy a prominent position in the museum.

KEY AWARDS

Astronauts Alan L. Bean, Owen K. Garriott and Jack R. Lousma, members of the S1-3 crew, were presented NASA's Distinguished Service Medal by Vice President Gerald Ford in ceremonies at the U.S. Capitol Feb. 6. That afternoon, Astronaut Bean of the Navy and Astronaut Lousma of the Marine Corps received DSMs from the commanders of their respective services.

LUNAR SAMPLE EXHIBITS

The following is a schedule of lunar sample exhibits from March 15 to April 15:

MEXICO—Ferias Y Exposiciones Mexicanas, Manual Ms. Contrereas Num. 133 Desp. 116 al 121, Mexico City, March 1-15.

MINNESOTA—Kennedy Lions Club Home and Hobby Show, Kennedy Community Center, Kennedy, March 29-31.

NEW JERSEY—IMPACT 5, Lawrence Township Public School, 2565 Princeton Pike, Trenton, March 27-April 3.

NEW YORK—United States Military Academy Open House, USMA, West Point, March 28-30.

OHIO—Industry and Science Display, 280 East Broad Street, Columbus, March 13-21.

TEXAS—American Association of Petroleum Geologists Annual Meeting, San Antonio Convention Center, Market at Alamo Streets, San Antonio, April 1-3; Houston Museum of Natural Science/History, Houston, March 15-April 15.

VIRGINIA—Old Dominion University of Engineering Open House, University Campus, Kaufman Hall, Norfolk, March 15-16.

WISCONSIN—Engineering and Science Exposition, University of Wisconsin, Platteville, March 22-23; 30th Annual Midwestern Regional Conference, Platteville, March 28-30.

Permanent Displays

ALABAMA—Alabama Space & Rocket Museum, Marshall Space Flight Center, Huntsville.

FLORIDA—Visitor Information Center, Kennedy Space Center.

KANSAS—Eisenhower Library, 200 S. E. 4th Street, Abilene.

NEW YORK—United Nations Building.

OHIO—U.S.A.F. Museum, Wright Patterson Air Force Base.

TEXAS—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.

VIRGINIA—Visitor Information Center, Langley Research Center, Hampton.

WASHINGTON, DC—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive.

HEADQUARTERS PRESS RELEASES

(Issued by the Public Information Division, Code FP, Headquarters, Washington, DC 20546. These releases are available only to members of the news media.)

74–33 Windmill Studied at NASA Center
74–34 Hughes Aircraft Co. Selected for Pioneer Venue Spacecraft
74–35 KSC Extends Boeing Contract
74–36 NASA to Launch British Satellite
74–37 Astronaut Schmidt Named Energy Coordinator
74–38 SEPS Study Underway at Marshall
74–39 San Marco C–2 Press Kit
74–40 Dr. Jenkins Assumes Post as OEO Deputy Administrator
74–41 New Life on Mars Film
74–42 Dale Myers Returning to Private Industry
74–43 Pioneers 10 and 11 Status Report
74–44 Mariner May Supply Answers to Mercury Mysteries
74–45 Wind Energy Fact Sheet
74–46 Note to Editors on 5th Annual Lunar Science Conference
74–47 Solar Energy Fact Sheet
74–48 Disher Named Deputy Director Advanced Programs
74–49 ASTP Emblem Selected
74–50 Mariner 10 to Observe Sun's Effect on Mercury

RADIO-TELEVISION
(Released Nationally)

March

TELEVISION—A monthly color television film, *Aeronautics and Space Report*, "ATS-F," featuring Wernher von Braun.

RADIO—Four weekly *Space Story* programs are to be released: "Future Manned Flight," (Hqs/Myers); "Unmanned Launch Operations," (KSC/Neilson); "Mariner to Mercury Encounter," (JPL/Dr. Dunne); and "Mariner 10-Venus Results," (JPL/Giberson). One monthly *NASA Special Report*, "Mariner 10 Encounters Mercury."

Samples from the seven experiments conducted aboard Skylab in the M-518 Multipurpose Electric Furnace during the last manned flight and from one student experiment are now ready for analysis by the principal investigators.

Some of the samples already are in the hands of the scientists and others will be delivered shortly. All samples have been removed from their cartridges, examined visually, and X-rayed.

NASA's two Jupiter Pioneer spacecraft are continuing to push outward the limits of explored space.

Pioneer 10, as of Feb. 19, was 60 million kilometers (37 million miles) beyond Jupiter, while Pioneer 11 was completing its trip through the Asteroid Belt.

Pioneer 10 flew by Jupiter last Dec. 3 and returned pictures and much information on the giant planet. In mid-February, it was 913 million kilometers (567 million miles) from Earth, the farthest distance yet attained by a man-made object.

NASA has revealed plans to build and install a three-meter (120-inch) infrared telescope, the world's largest, on Mauna Kea, the highest mountain in Hawaii. It will be operated for the space agency as a nationally available facility by the University of Hawaii, under the overall supervision of Dr. William Brunk, Chief of Planetary Astronomy at NASA Headquarters.

Infrared astronomy is one of the latest and most rapidly expanding fields in astronomy. The new facility will be used primarily to provide supporting and complementary data to NASA's planetary exploration programs.

Two representatives from the 10-nation European Space Research Organization (ESRO), the organization that will develop and build the Spacelab element for use with the Space Shuttle, flew aboard Galileo II, NASA's flying laboratory, when it recently operated out of Hawaii to evaluate electronic instrumentation designed to measure sea conditions. They were interested in seeing at first hand how it operates, for the Shuttle sortie missions will be patterned after it.

NASA TECH BRIEFS

(The Technology Utilization Office, NASA Headquarters)

(The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU Office at the originating NASA Center.)

Innovator(s)	*Title*	*Number*	*Center*
James J. Kerley, Jr., and Norman C. Schaller, Goddard Space Flight Center	A Multidegree-of-Freedom Vibrational Apparatus	73-10332	GSFC
Jack Evans and William I. Gould, Jr., Goddard Space Flight Center	Millimeter-Wave Antenna System	73-10333	GSFC
Leonard L. Klienberg, Goddard Space Flight Center	Active Tuning Circuit	73-10334	GSFC
Peter B. Mumola and Belton T. McAlexander, Langley Research Center	A Laser Head for Simultaneous Optical Pumping of Several Dye Lasers.	73-10336	LaRC
K. P. Joncas, S. Birnbach and M. Lambert III, Avco Corp.	Dynamic Power Load Simulator	73-10305	JSC
T. E. Flanders and G. Kosa, General Electric Co.	RF to Digital Converter	73-10306	JSC
R. W. O'Neill, Lockheed Aircraft Corp.	Peak-Holding Circuit for Extremely Narrow Pulses	73-10317	JSC
P. W. Shores, Johnson Space Center	Scanning Beacon Locator System: A Concept	73-10318	JSC
W. G. Bouricus and B. J. Flehinger, IBM Corp.	A New Algorithm for Finding Survival Coefficients Employed in Reliability Equations.	73-10256	MSFC
R. L. Hansen, GTE Sylvania, Inc.	Fast Recharge Circuit for Q-Switched Lasers	73-10257	GSFC

NASA TECH BRIEFS—Cont.

Inventor(s)	*Title*	*Number*	*Center*
J. R. Barber, Lewis Research Center, and H. E. Johnson and K. T. Eugene, Lockheed Missiles & Space Co.	Improved Fiberglass-to-Metal Joint Produces Lighter Stronger Fiberglass Strut.	73-10258	LeRC
Robert J. Mattauch and Thomas J. Viola, Jr., University of Virginia	Frequency Shifting with a Solid-State Switching Capacitor.	73-10259	Hdqrs.
Benjamin Z. Meers, Jr., Kennedy Space Center	Digital Notch Filter	73-10112	KSC
Gerald V. Brown, Lewis Research Center	Magnetocaloric Pump	73-10124	LeRC
Dariene Deen and Wayne R. Mantay, Langley Research Center, and S. Gene Sadler, Rochester Applied Research Associates, Inc.	Method for Predicting Rotor Free-Wake Positions and the Resulting Rotor Blade Airloads.	73-10239	LaRC
R. J. Platt, Jr., L. B. Thurston, Jr., and R. M. Baucom, Langley Research Center	Bonded Panel, Flaw Detection Standards	73-10240	LaRC
Judd R. Wilkins, Albin O. Pearson and Stacey M. Mills, Langley Research Center	Measuring Micro-Organism Gas Production	73-10241	LaRC
Leonard M. Weinstein, Langley Research Center	Improved Photographic Prints with a Linear Radial Transmission Filter.	73-10242	LaRC
W. N. Reynolds and A. H. Striepens, Rockwell International Corp.	Graphite/Polyimide Laminates with Near-Zero Thermal Expansion.	73-10254	JSC
C. Bruce Johnson and Kenneth L. Hallam, Bendix Corp.	A Magnetically Focused Image Tube Employing an Opaque Photocathode.	73-10255	GSFC
G. L. Fogal, General Electric Co.	Zeta Potential Control for Electrophoresis Cells	73-10260	MSFC
H. Heskett, J. Meincer and A. L. Inglis, Martin Marietta Corp.	Electroshock Protection Circuit	73-10261	JSC
I. R. Abel, Honeywell, Inc.	Wide-Field Reflective Scanning Optical Systems	73-10279	JSC
G. A. Phlieger, Kennedy Space Center	Pressuredized Lighting System	73-20280	KSC
Vernon L. Bell, Langley Research Center	Preparing Thermoplastic Aromatic Polyimides	73-10319	LaRC
R. Smith and T. Carr, SCI Systems, Inc.	Eight-Channel Telephone Telemetry System	73-10320	JSC
F. J. Moskal and J. D. Fageol, Rockwell International Corp.	Acoustic-Emission Signal-Processing Analog Unit for Locating Flaws in Large Tanks.	73-10325	MSFC
M. A. Honnel and J. K. Newell, Auburn University	Isolated Output for Class-D DC Amplifiers	73-10331	MSFC
O. E. Accountius, Rockwell International Corp.	Improved Mold Release for Filled-Silicone Compounds	73-10338	JSC
C. L. Deuel, N. W. Hultgren and M. L. Mobert, Analytical Research Laboratories, Inc.	Dynamic Technique for Measuring Absorption in a Gas Chromatograph.	73-10339	JSC
W. H. Kinard and R. L. O'Neal, Langley Research Center, and J. J. Wortman, R. P. Donovan, A. D. Brooks and L. K. Monteith, Research Triangle Institute	Particulate and Aerosol Detector	73-10357	LaRC
Paul D. Carter, Robert E. Layton and Francis W. Stratton, The Boeing Co.	New Concept in Brazing Metallic Honeycomb Panels	73-10358	LaRC
George A. Viernson, GTE Sylvania Corp.	Digital TV Image Enhancement System	73-10285	GSFC
Theodore R. Beck, Charles J. Bishop and W. F. Springgate, The Boeing Co.	A New Method for the Determination of Thin Film Porosity.	73-10286	Hdqrs.
D. R. Butler, D. T. Schowalter and D. C. Weil, Raymond Loewy/William Snaith, Inc.	Shuttle Orbiter Storage Locker System: A Study	73-10287	JSC
Philip A. Studer, Goddard Space Flight Center	An Electric Motor with Magnetic Bearings: A Concept	73-10304	GSFC

PATENTS AND INVENTIONS RESULTING FROM NASA RESEARCH

(The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.)

Inventor(s) and Employer	*Title of Invention*	*Patent No.*	*Installation*
Josef F. Blumrich, NASA/MSFC	Omnidirectional Wheel	3,789,947	MSFC
Ramesh C. Tyagi, National Research Council; James B. Robertson, NASA/LaRC; and Karl W. Boer and Henry C. Hadley, Jr., both of the University of Delaware.	High Field CDS Detector for Infrared Radiation	3,790,795	LaRC
Richard S. Bogner and Charles D. Farris, ESB, Inc., Raleigh, NC, and JPL.	Improved Storage Battery	3,790,409	NaPO
Philip A. Clements, Caltech/JPL	System for Stabilizing Cable Phase Delay Utilizing a Coaxial Cable Under Pressure.	3,790,906	NaPO
Ralph W. Kalkbrenner, Westinghouse, Pittsburgh, PA.	Heat Transfer Device	3,789,920	NaPO
Robert A. Jones, NASA/LaRC	Method for Determining Thermophysical Properties of Specimens.	3,789,654	LaRC
Thomas A. Cook and Hans Scheibe, McDonnell Douglas Corp., Huntington Beach, CA.	Metering Gas Dispensing Precisely Measures Charges of Fluid.	3,790,037	MSFC
Wilbur C. Heier, NASA/LaRC	Apparatus and Method of Molding	3,790,650	LaRC
Richard Van Auken, Whittaker Corp., San Diego, CA.	Reinforced Polyquinoxaline Gasket and Method of Preparing the Same.	3,790,432	MSFC
Charlie M. Jackson and Dallas G. Summerfield, NASA/LaRC.	Wind Tunnel Model and Method	3,791,207	LaRC
Robert B. Kimball, David T. Hodder, Walter W. Wrinkle (deceased), all of North American Rockwell Corp., Oowney, CA.	Apparatus for Remote Handling of Materials	3,790,347	LaRC

1974 LAUNCH SCHEDULE

Name	*Launch Date*	*Vehicle*	*Range*	*Mission/Remarks*	
Skynet II–A (UK)	Jan. 18	Delta	ETR	Reimbursable launch. United Kingdom's communications satellite.	Launched Vehicle failure
Centaur Proof Flight	Feb. 11	Titan III–E Centaur	ETR	Test flight of booster planned for Viking Mars launch in 1975.	Launched Engine failure
San Marco (SM–C2)	Feb. 18	Scout	SM	United States/Italy cooperative mission to conduct air density measurements.	Launched
UK X–4	Mar. 8	Scout	WTR	Reimbursable launch. United Kingdom technology satellite with experiments related to spacecraft power systems, attitude control and stabilization.	
WESTAR–A	April	Delta	ETR	Western Union communications satellite. Reimbursable launch.	
ATS–F	April	Titan III–C	ETR	Developmental and demonstrative communications mission using technology applicable to terrestrial and space needs; utilizes 9.15-meter (30-foot) deployable parabolic antenna and communications system with frequencies in several bands; will support public communications experiments in the U.S. and India.	
SMS–A	May	Delta	ETR	First prototype/developmental mission for geostationary meteorological operational satellite system; day and night continuous imaging of cloud cover; sophisticated remote-platform data-collection-and-weather data relay.	

1974 LAUNCH SCHEDULE—Cont.

Name	*Launch Date*	*Vehicle*	*Range*	*Mission/Remarks*
Hawkeye (formerly Injun-F)	May	Scout	WTR	To study the topology of the magnetic field at large radial distance over the Earth's dgear caps and the interaction of the solar winds with the geomagnetic field.
Intelsat IV F–8 ..	June	A–Centaur ..	ETR	One of a series of communications satellites to form part of a global communication commercial satellite system. Launch for COMSAT.
Nimbus F	June	Delta	WTR	Meteorological research and development mission to test instruments for expanding atmospheric remote sensing to cloud regions, extend observations to new spectral regions, extend sounding capabilities to higher altitudes, demonstrate feasibility for improvements to operational systems, and support GATE.
WESTAR–B	June	Delta	ETR	Western Union communications satellite. Reimbursable launch.
SMS–B	July	Delta	ETR	Second prototype/developmental mission for geostationary meteorological operational satellite system; same as SMS–A; SMS–A and SMS–B will support GARP Atlantic Tropical Experiment (GATE).
ITOS–G	July	Delta	WTR	Polar-orbiting operational meteorological satellite funded by NOAA; day and night cloud cover and temperature sounding.
AEROS–B (German)	July	Scout	WTR	Spin-stabilized, Earth-orbiting satellite designed for upper atmosphere measurements.
Netherlands Sat.–A (ANS–A)	August ..	Scout	WTR	Designed to obtain data from celestial X-ray and ultraviolet sources.
GOES–A (SMS–C)	August ..	Delta	ETR	First Geostationary Operational Environmental Satellite, follow-on to SMS missions, funded by NOAA.
Helios–A	2nd Half	Titan III	ETR	To investigate the properties of and processes in interplanetary space in the direction of and close to the Sun by developing, launching and operating automated spacecraft.
Intelsat IV F–6 ..	3rd Qtr. ..	.....	.....	One of a series of communications satellites to form part of a global communications commercial satellite system. Launch for COMSAT.
Skynet II–B (UK)	3rd Qtr. ..	Delta	ETR	Reimbursable launch. United Kingdom communications satellite.
WESTAR–C	October ..	Delta	ETR	Western Union communications satellite. Reimbursable launch.
Comsat–A	4th Qtr. ..	Delta	ETR	First of two maritime communications satellites to be situated over Atlantic and Pacific Oceans.
Symphonie–A (French/German)	4th Qtr. ..	Delta	ETR	Experimental communications satellite. Reimbursable.
Intelsat IV F–1 ..	4th Qtr. ..	.....	.....	One of a series of communications satellites to form part of a global communication commercial satellite system. Launch for COMSAT.
UK–5	(Under Study)	.....	.....	To investigate galactic and extra galactic X-ray sources.
GEOS–C	July	Delta	WTR	Geodynamic Experimental Ocean Satellite to demonstrate feasibility of satellite-altimeter techniques for measuring the topography of the ocean surface; can be significant contribution to understanding of ocean dynamics.

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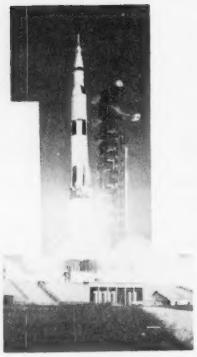

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